Archaeological Services WYAS

Land at Whitehouse Farm
Chichester
West Sussex

Geophysical Survey

Report no. 2671

December 2014

Client: Environmental Dimension Partnership Ltd

Registered IfA Organisation

Land at Whitehouse Farm
Chichester
West Sussex

Geophysical Survey

Summary

A geophysical (magnetometer) survey covering approximately 8 hectares was carried out at Whitehouse Farm, west of Chichester, in order to assess the viability of magnetometry to detect known and unknown archaeological features across part of a much larger (122ha) proposed development area. A cart based Sensys magnetometer system was used for the survey with a smaller sub-set also surveyed using conventional hand held (Bartington) magnetometers for purposes of data comparison. A linear anomaly, likely to be due to a soil filled anti-tank ditch, has been clearly identified. In addition a second curvilinear anomaly is likely to also be caused by a soil filled ditch and is probably a former (unmapped) boundary feature of unknown date. A cluster of anomalies of uncertain origin may also be of archaeological interest. Consequently the survey has demonstrated that magnetometry has the potential to locate further anomalies of archaeological origin on the prevailing soils and geology and that this technique can be considered to be a reliable method of assessing the archaeological potential of the remainder of the site.

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Report Information

Client:	Environmental Dimension Partnership Ltd
Address:	Tithe Barn, Barnsley Park Estate, Barnsley, Cirencester, Gloucestershire, GL7 5EG
Report Type:	Geophysical Survey
Location:	Chichester
County:	West Sussex
Grid Reference:	SU 844 055
Period(s) of activity:	post-medieval/modern
Report Number:	2671
Project Number:	4311
Site Code:	AAC14
OASIS ID:	archaeol11- 197061
Planning Application No.:	n/a
Museum Accession No.:	n/a
Date of fieldwork:	November 2014
Date of report:	November 2014
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Photography:	Dan Waterfall
Research:	n/a

Authorisation for distribution: --

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1 Introduction

Archaeological Services WYAS (ASWYAS) were commissioned by Eddy Stratford of the Environmental Dimension Partnership (the Consultant), on behalf of their clients, Linden Homes and Miller Homes, to undertake a geophysical (magnetometer) survey of land to the west of Chichester, West Sussex (see Fig. 1). The survey area forms a small part of a much larger proposed development area (PDA) and the results from this pilot study will be used to inform future archaeological strategy over the wider development area. The work was undertaken in accordance with a Project Design (Harrison 2014) supplied to the Consultant and approved by the Archaeology Officer of Chichester District Council, with guidance contained within the National Planning Policy Framework (NPPF 2012) and in line with current best practice (David *et al*. 2008). The survey was carried out between November 3rd and November 6th 2014 in order to provide additional information on the archaeological potential of the site.

Site location, topography and land-use

The Proposed Development Area (PDA), which covers approximately 122 hectares, is situated west of Chichester adjacent to Whitehouse Farm. The pilot study area is towards the southern end of the PDA, and is centred at SU 844 055. It is bound by Salthill Lane to the north and agricultural land to all other sides. Newbridge Farm is located on the south-western corner and the A27 runs north/south approximately 120m west of the survey area (see Fig. 2). The survey area comprised a single field of about 8.1 hectares which was lying fallow after recent arable cultivation. A small area to the south-western corner was waterlogged (see Plate 2) and omitted from the survey area.

The survey area slopes very gradually down from north to south and is situated at approximately 10m above Ordnance Datum (aOD).

Soils and geology

The underlying bedrock comprises London Clay Formation (clay, silt and sand) which is overlain by superficial deposits of gravel, sand, silt and clay as well as undifferentiated river terrace deposits, also of sand, silt and clay (British Geological Survey 2014). The soils are classified in the Park Gate association being characterised as deep stoneless silts, variably affected by groundwater (Soil Survey of England and Wales 1983).

2 Archaeological Background

An Archaeological and Heritage Assessment (EDP 2014) has identified two designated heritage assets within the overall PDA, comprising of a scheduled monument (SM) and a Grade II listed building. The scheduled monument relates to a north/south section of the Chichester Entrenchments (Late Iron Age defensive features), which comprise a bank and ditch along the east side of Broyle Copse and extending south towards the B2178, Old Broyle Road. Several further scheduled monuments are recorded within the wider landscape including Fishbourne Roman Palace, located 370m south-west of the PDA.

Undesignated heritage assets are also known within the PDA including a section of the Hook Dyke, a bank and ditch of Iron Age and Romano British Date. The B2178 Old Broyle Road, which passes through the north-east of the PDA is thought to follow the route of a Roman road and finds of pottery alongside the road may indicate the site of a villa.

Two trenches were recently excavated in the south-west of the PDA (see Fig. 2) to investigate the line of the Hook Dyke (Cotswold Archaeology 2014). The evaluation identified Roman pottery and ceramic building material from within a ditch in one of the trenches and the report concluded that, whilst the ditch is unlikely to be part of the Hook Dyke or Chichester Entrenchments that it may relate to the postulated line of the Roman road which issued out of the West Gate at Chichester. A deep linear feature, parallel with the field boundary immediately to the south, revealed in plan at the southern end of both trenches (and partially excavated but not bottomed) in the westernmost trench, has been interpreted as a World War II anti-tank ditch.

3 Aims, Methodology and Presentation

The aims and objectives of the programme of geophysical survey are to gather sufficient information to establish the presence/absence, character, extent, of any archaeological remains within the specific areas to be impacted by the proposed development), and to inform further strategies should they be necessary.

More specifically, the aims of the survey are:

- To assess the value of magnetometer survey on the prevailing bedrock and superficial geologies by targeting the linear features identified in the recent evaluation trenches;
- to provide information about the nature and possible interpretation of any magnetic anomalies identified;
- to therefore determine the presence/absence and extent of any buried archaeological features;
- to produce a comprehensive site archive and report.

Magnetometer survey

The area was surveyed using five Sensys Magneto MXPDA magnetometers mounted at 0.5m intervals on a cart system taking readings at 0.125m intervals, allowing 18000 readings to be recorded in a 30m by 30m square. The system is connected to a Trimble R6 RTK GPS system allowing each individual reading to be logged accurately; no site grid is required. The readings are stored in the memory of the instrument and later downloaded for processing and interpretation using MAGNETO (Sensys Gmbh) software was be used to process and present the data.

Part of the site was re-surveyed using conventional Bartington Grad601 magnetic gradiometers, taking readings at 0.25m intervals on zig-zag traverses 1m apart within 30m by 30m grids, so that 3600 readings were recorded in each grid. These readings were stored in the memory of the instrument and later downloaded to computer for processing and interpretation. Geoplot 3 (Geoscan Research) software was used to process and present the data. Further details are given in Appendix 1. A site grid was laid out using a Trimble VRS differential Global Positioning System (Trimble 5800 model) for this element of the work.

Reporting

A general site location plan, incorporating the 1:50000 Ordnance Survey (OS) mapping, is shown in Figure 1. Figure 2 is a large scale (1:3000) location plan displaying the processed greyscale magnetometer data and the location of two recently excavated trial trenches. Figures 3 and 4 present the data recorded by the cart-based Sensys system across the whole of the survey area in greyscale and X-Y traceplot formats at a scale of 1:1250. Figures 5 and 6 display a smaller sub-set carried out using the conventional hand-carried Bartington and displayed at the same scale and in the same format. Figure 7 is a combined interpretation of the whole survey area also at 1:1250. Further technical information on the equipment used, data processing and survey methodologies is given in Appendix 1 and Appendix 2. Appendix 3 describes the composition and location of the site archive.

The survey methodology, report and any recommendations comply with the Project Design (Harrison 2014) and guidelines outlined by English Heritage (David *et al.* 2008) and by the Institute for Archaeologists (IfA 2013). All figures reproduced from Ordnance Survey mapping are with the permission of the controller of Her Majesty's Stationery Office (© Crown copyright).

The figures in this report have been produced following analysis of the data in 'raw' and processed formats and over a range of different display levels. All figures are presented to most suitably display and interpret the data from this site based on the experience and knowledge of Archaeological Services staff.

4 Results and Discussion (Figs 3 to 7 inclusive)

Ferrous Anomalies

Ferrous anomalies, as individual ‘spikes’, are typically caused by ferrous (magnetic) material, either on the ground surface or in the plough-soil. Little importance is normally given to such anomalies, unless there is any supporting evidence for an archaeological interpretation, as modern ferrous debris or material is common on most sites, often being present as a consequence of manuring or tipping/infilling. There is no obvious pattern or clustering to their distribution on this site to suggest anything other than a random background scatter of ferrous debris in the plough-soil.

Agricultural Anomalies

Throughout the survey area closely spaced linear trend anomalies aligned north-west/south-east are clearly identified by both the cart-based and hand carried systems. These anomalies are caused by recent ploughing. Other linear trend anomalies around the periphery of the field are also thought to have an agricultural origin, probably also ploughing.

The exception is Anomaly **A** around the southern edge of the survey area. This anomaly is clearly recorded by the Bartington system but is barely visible in the data recorded by the cart-based system. This feature is assumed to be the curvilinear feature (anti-tank ditch) which was identified in the two evaluation trenches. The reason for this variation is likely to be due to the difference in orientation of the traverses by each survey. During the Bartington (hand-carried) survey the traverses were aligned north/south and therefore roughly perpendicular to the line of the ditch feature (tank trap). However, the cart survey (non-grid based) followed arcing traverses parallel with the southern field boundary and was therefore exactly surveying along the line of the feature thereby rendering it almost undetectable.

Possible Archaeological Anomalies

A curvilinear anomaly, **B**, extending from west to east across the centre of the survey area is probably caused by a sub-surface soil-filled ditch. Although the feature has not been identified on any historic mapping it does intersect existing boundaries on both the eastern and western sides of the site at points at which the orientation of the existing boundary changes. Whilst a post-medieval date for this feature is considered probable a much older archaeological origin cannot be dismissed.

In the south-western corner of the survey area a cluster of anomalies, **C**, is clearly identified in both data sets. These anomalies clearly stand out against the generally very low magnetic background across the site as a whole. The origin of this anomaly is unclear but given the archaeological potential of the surrounding landscape an archaeological origin must be considered.

5 Conclusions

A broad linear anomaly parallel with, and immediately north of, the field boundary to the south appears to correlate with the wide (2.2m) linear feature identified in both the two evaluation trenches. This feature has been interpreted as a World War II anti-tank ditch. A second, much smaller and shallower, ditch feature identified in the easternmost of the two trenches has not been specifically recorded as a magnetic anomaly although numerous ploughing trend anomalies on the same alignment have been located. It is not clear whether the excavated feature is simply too shallow to enable it to be detected or possibly that the feature is a plough furrow or other shallow modern feature containing residual Roman material.

Based on the results of the sample survey, the archaeological potential of this part of the PDA is relatively low with the notable exception of the areas immediately adjacent to previously located features and the two anomalies identified by the current survey.

Both the hand carried and cart based magnetometer systems have clearly demonstrated that there is likely to be sufficient magnetic contrast to detect sub-surface archaeological features on the prevailing soils and superficial deposits. Therefore, magnetometry must be considered as a suitable technique by which to evaluate the archaeological potential of the remainder of this site.

The results and subsequent interpretation of data from geophysical surveys should not be treated as an absolute representation of the underlying archaeological and non-archaeological remains. Confirmation of the presence or absence of archaeological remains can only be achieved by direct investigation of sub-surface deposits.

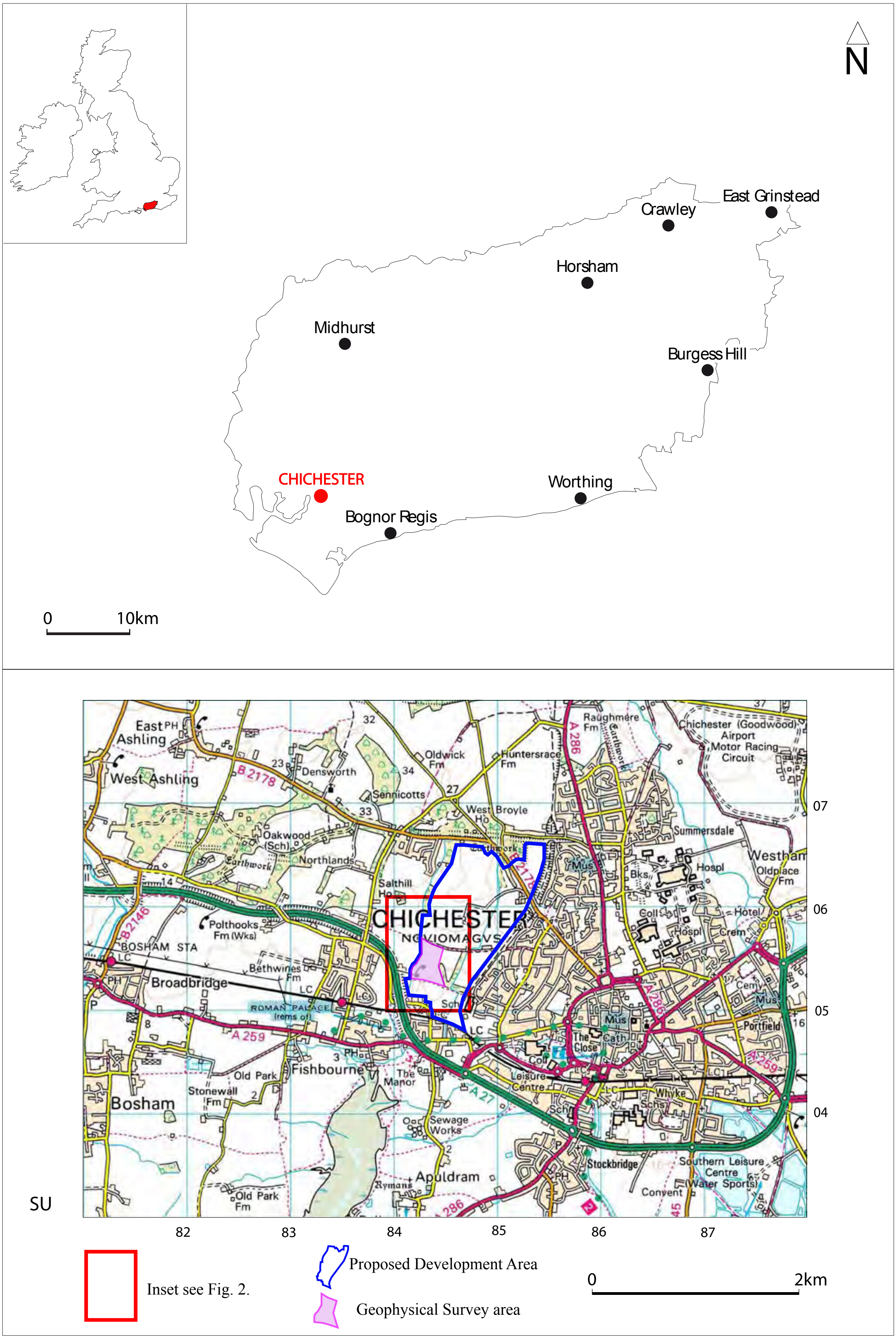

Fig. 1. Site location

Fig. 2. Site location showing survey boundary and magnetometer data (1:3000 @ A3)

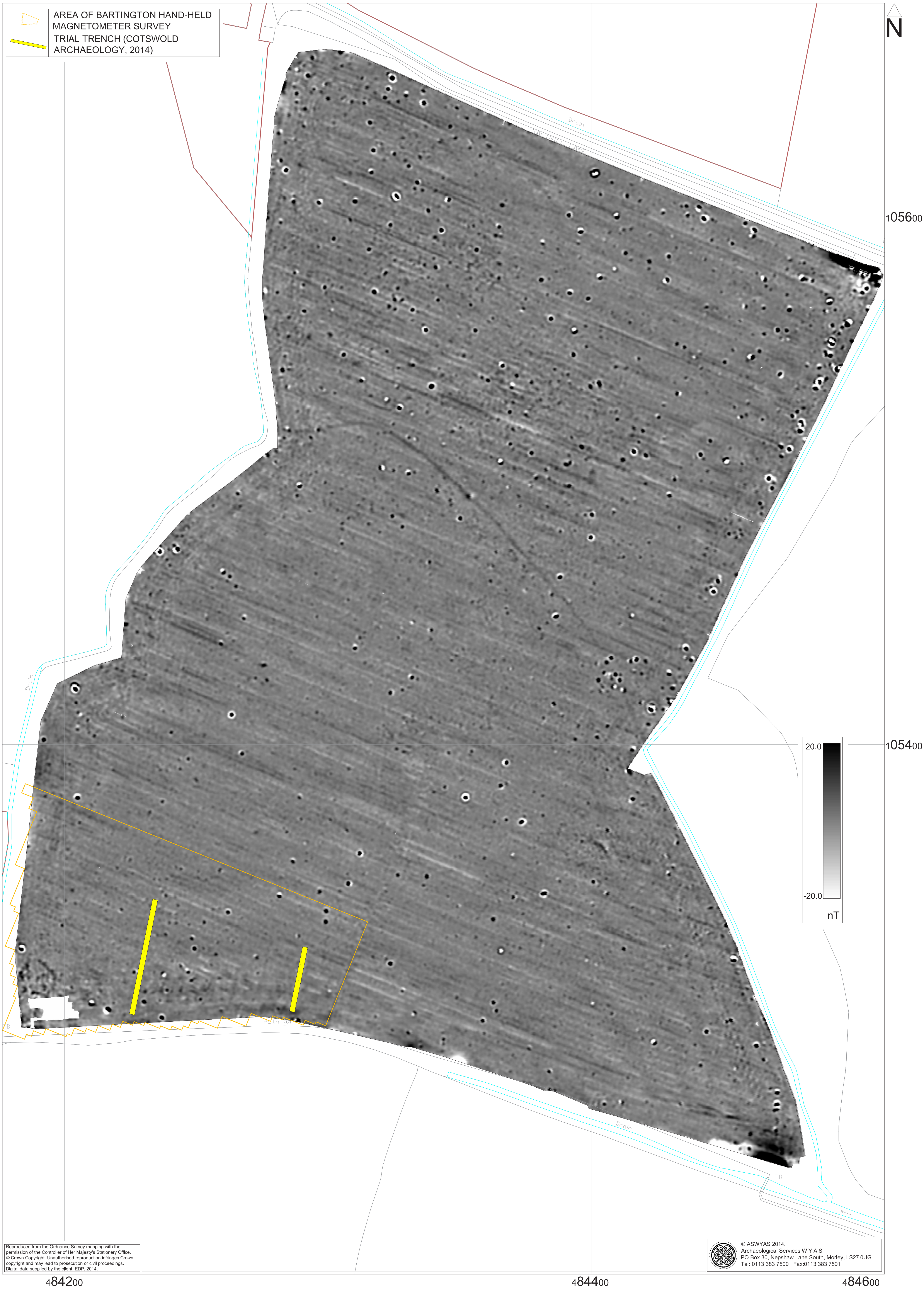

Fig. 3. Processed greyscale magnetometer data; Sensys cart based system (1:1250 @ A3)

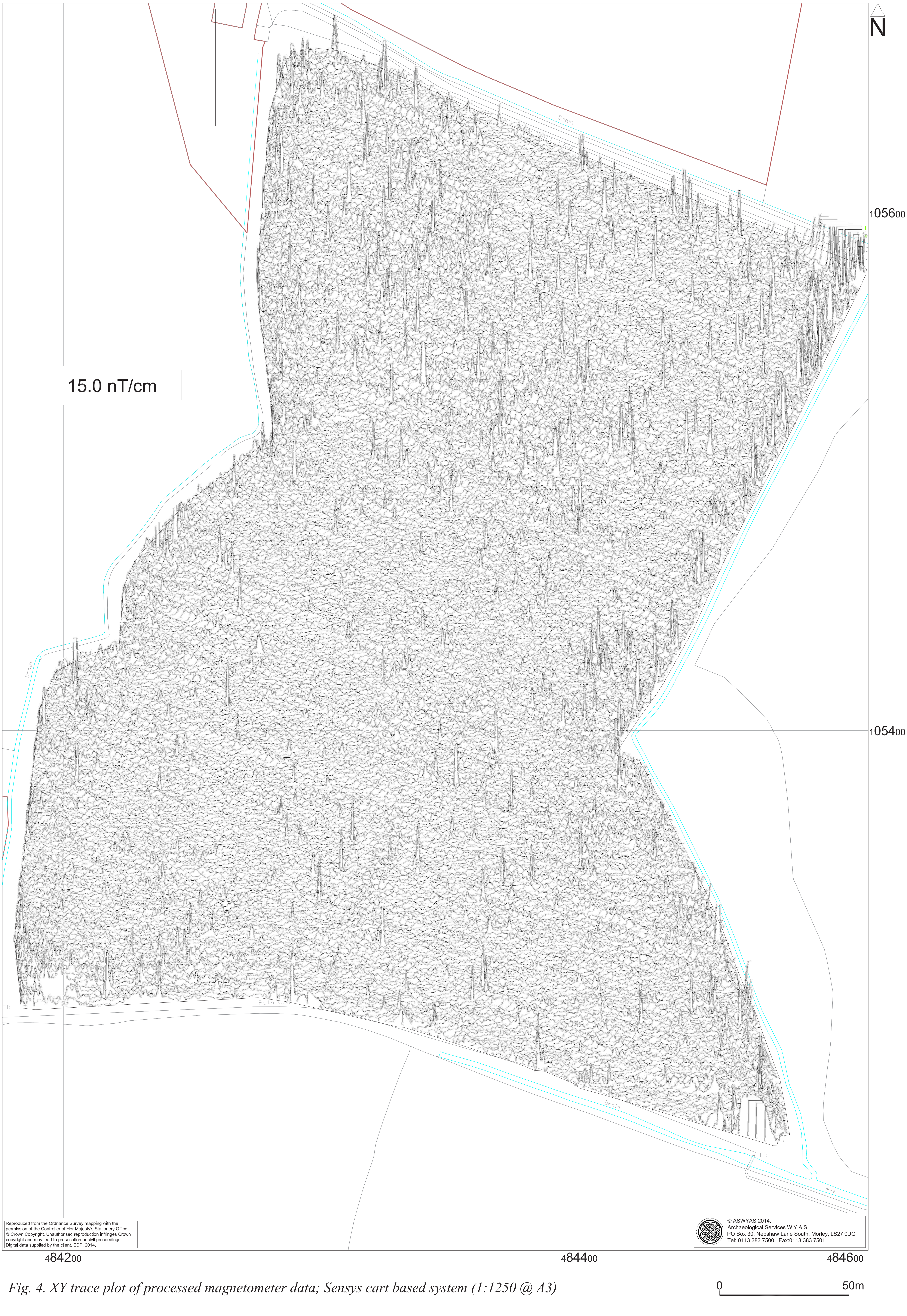

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Fig. 4. XY trace plot of processed magnetometer data; Sensys cart based system (1:1250 @ A3)

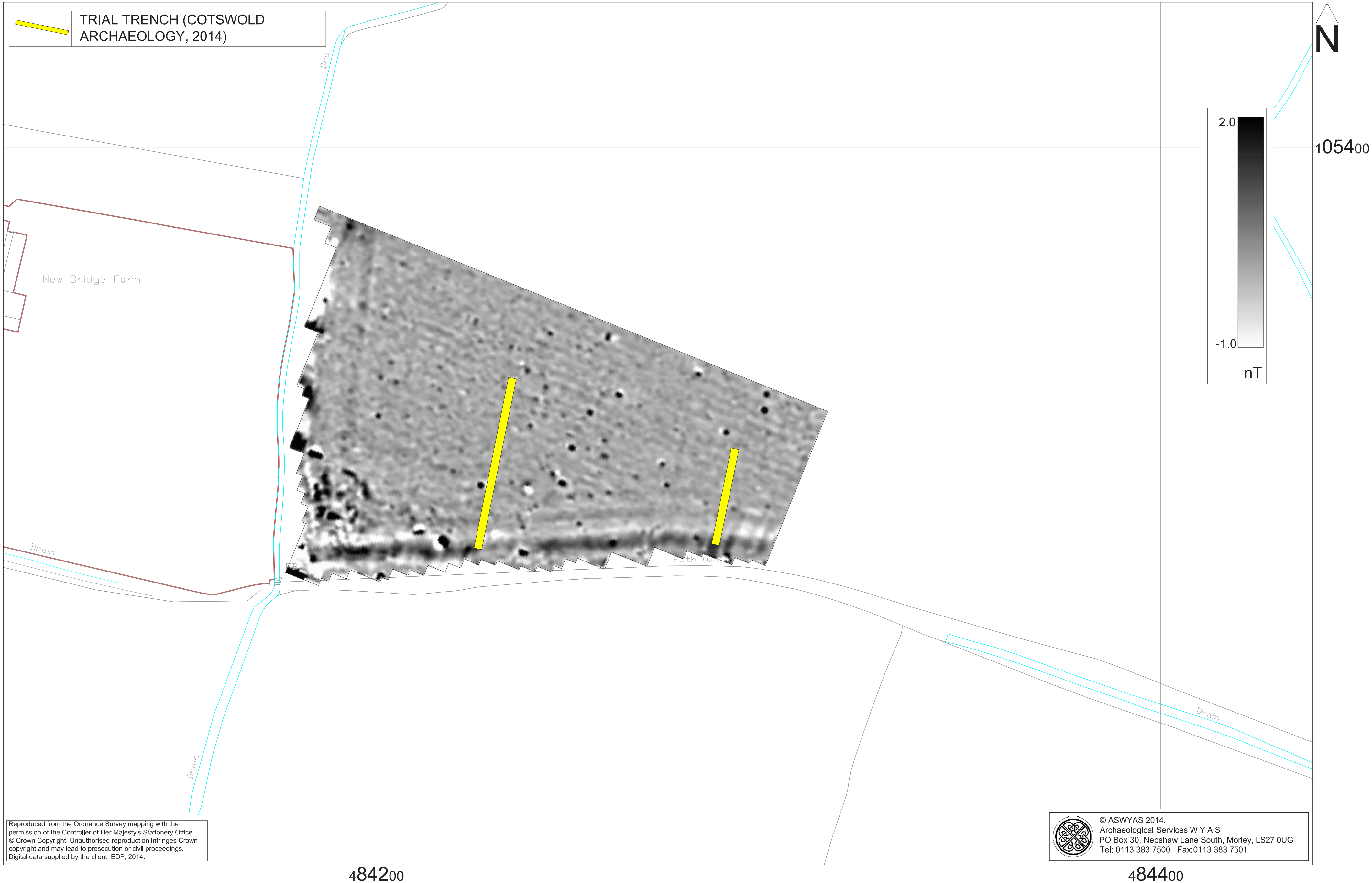

Fig. 5. Processed greyscale magnetometer data - Bartington hand carry system (1:1250 @ A4)

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Fig. 6. XY trace plot of minimally processed magnetometer data - Bartington hand carry system (1:1250 @ A4)

Fig. 7. Interpretation of magnetometer data (1:1250 @ A3)

0 50m

Plate 1. General view of survey area, looking north-east

Plate 2. View of waterlogged area, looking east

Appendix 1: Magnetic survey - technical information

Magnetic Susceptibility and Soil Magnetism

Iron makes up about 6% of the Earth's crust and is mostly present in soils and rocks as minerals such as maghaemite and haemetite. These minerals have a weak, measurable magnetic property termed magnetic susceptibility. Human activities can redistribute these minerals and change (enhance) others into more magnetic forms so that by measuring the magnetic susceptibility of the topsoil, areas where human occupation or settlement has occurred can be identified by virtue of the attendant increase (enhancement) in magnetic susceptibility. If the enhanced material subsequently comes to fill features, such as ditches or pits, localised isolated and linear magnetic anomalies can result whose presence can be detected by a magnetometer (fluxgate gradiometer).

In general, it is the contrast between the magnetic susceptibility of deposits filling cut features, such as ditches or pits, and the magnetic susceptibility of topsoils, subsoils and rocks into which these features have been cut, which causes the most recognisable responses. This is primarily because there is a tendency for magnetic ferrous compounds to become concentrated in the topsoil, thereby making it more magnetic than the subsoil or the bedrock. Linear features cut into the subsoil or geology, such as ditches, that have been silted up or have been backfilled with topsoil will therefore usually produce a positive magnetic response relative to the background soil levels. Discrete feature, such as pits, can also be detected. The magnetic susceptibility of a soil can also be enhanced by the application of heat and the fermentation and bacterial effects associated with rubbish decomposition. The area of enhancement is usually quite large, mainly due to the tendency of discard areas to extend beyond the limit of the occupation site itself, and spreading by the plough. An advantage of magnetic susceptibility over magnetometry is that a certain amount of occupational activity will cause the same proportional change in susceptibility, however weakly magnetic is the soil, and so does not depend on the magnetic contrast between the topsoil and deeper layers. Susceptibility survey is therefore able to detect areas of occupation even in the absence of cut features. On the other hand susceptibility survey is more vulnerable to the masking effects of layers of colluvium and alluvium as the technique, using the Bartington system, can generally only measure variation in the first 0.15m of ploughsoil.

Types of Magnetic Anomaly

In the majority of instances anomalies are termed 'positive'. This means that they have a positive magnetic value relative to the magnetic background on any given site. However some features can manifest themselves as 'negative' anomalies that, conversely, means that the response is negative relative to the mean magnetic background.

Where it is not possible to give a probable cause of an observed anomaly a '?' is appended.

It should be noted that anomalies interpreted as modern in origin might be caused by features that are present in the topsoil or upper layers of the subsoil. Removal of soil to an archaeological or natural layer can therefore remove the feature causing the anomaly.

The types of response mentioned above can be divided into five main categories that are used in the graphical interpretation of the magnetic data:

Isolated dipolar anomalies (iron spikes)

These responses are typically caused by ferrous material either on the surface or in the topsoil. They cause a rapid variation in the magnetic response giving a characteristic 'spiky' trace. Although ferrous archaeological artefacts could produce this type of response, unless there is supporting evidence for an archaeological interpretation, little emphasis is normally given to such anomalies, as modern ferrous objects are common on rural sites, often being present as a consequence of manuring.

Areas of magnetic disturbance

These responses can have several causes often being associated with burnt material, such as slag waste or brick rubble or other strongly magnetised/fired material. Ferrous structures such as pylons, mesh or barbed wire fencing and buried pipes can also cause the same disturbed response. A modern origin is usually assumed unless there is other supporting information.

Linear trend

This is usually a weak or broad linear anomaly of unknown cause or date. These anomalies are often caused by agricultural activity, either ploughing or land drains being a common cause.

Areas of magnetic enhancement/positive isolated anomalies

Areas of enhanced response are characterised by a general increase in the magnetic background over a localised area whilst discrete anomalies are manifest by an increased response (sometimes only visible on an XY trace plot) on two or three successive traverses. In neither instance is there the intense dipolar response characteristic exhibited by an area of magnetic disturbance or of an 'iron spike' anomaly (see above). These anomalies can be caused by infilled discrete archaeological features such as pits or post-holes or by kilns. They can also be caused by pedological variations or by natural infilled features on certain geologies. Ferrous material in the subsoil can also give a similar response. It can often therefore be very difficult to establish an anthropogenic origin without intrusive investigation or other supporting information.

Linear and curvilinear anomalies

Such anomalies have a variety of origins. They may be caused by agricultural practice (recent ploughing trends, earlier ridge and furrow regimes or land drains), natural geomorphological features such as palaeochannels or by infilled archaeological ditches.

Methodology: Magnetic Susceptibility Survey

There are two methods of measuring the magnetic susceptibility of a soil sample. The first involves the measurement of a given volume of soil, which will include any air and moisture that lies within the sample, and is termed volume specific susceptibility. This method results in a bulk value that it not necessarily fully representative of the constituent components of the sample. For field surveys a Bartington MS2 meter with MS2D field loop is used due to its speed and simplicity. The second technique overcomes this potential problem by taking into account both the volume and mass of a sample and is termed mass specific susceptibility. However, mass specific readings cannot be taken in the field where the bulk properties of a soil are usually unknown and so volume specific readings must be taken. Whilst these values are not fully representative they do allow general comparisons across a site and give a broad indication of susceptibility changes. This is usually enough to assess the susceptibility of a site and evaluate whether enhancement has occurred.

Methodology: Gradiometer Survey

Conventional gradiometer survey, using hand-held magnetometers, employs the use of a sample trigger to automatically take readings at predetermined points, typically at 0.25m intervals, on zig-zag traverses 1m apart within grids sometimes 20m by 20m but now more usually 30m by 30m. These readings are stored in the memory of the instrument and are later downloaded to computer for processing and interpretation.

During this survey a Bartington Grad601 magnetic gradiometer was used taking readings on the 0.1nT range, at 0.25m intervals on zig-zag traverses 1m apart within 30m by 30m square grids. The instrument was checked for electronic and mechanical drift at a common point and calibrated as necessary. The drift from zero was not logged.

Data Processing and Presentation

The detailed gradiometer data has been presented in this report in XY trace and greyscale formats. In the former format the data shown is ‘raw’ with no processing other than grid biasing having been done. The data in the greyscale images has been interpolated and selectively filtered to remove the effects of drift in instrument calibration and other artificial data constructs and to maximise the clarity and interpretability of the archaeological anomalies.

An XY plot presents the data logged on each traverse as a single line with each successive traverse incremented on the Y-axis to produce a ‘stacked’ plot. A hidden line algorithm has been employed to block out lines behind major ‘spikes’ and the data has been clipped. The main advantage of this display option is that the full range of data can be viewed, dependent on the clip, so that the ‘shape’ of individual anomalies can be discerned and potentially archaeological anomalies differentiated from ‘iron spikes’. Geoplot 3 software was used to create the XY trace plots.

Geoplot 3 software was used to interpolate the data so that 3600 readings were obtained for each 30m by 30m grid. The same program was used to produce the greyscale images. All greyscale plots are displayed using a linear incremental scale.

Appendix 2: Survey location information

The site grid was laid out using a Trimble VRS differential Global Positioning System (Trimble 5800 model). The accuracy of this equipment is better then 0.01m. The survey grids were then super-imposed onto a base map provided by the client to produce the displayed block locations. However, it should be noted that Ordnance Survey positional accuracy for digital map data has an error of 0.5m for urban and floodplain areas, 1.0m for rural areas and 2.5m for mountain and moorland areas. This potential error must be considered if co-ordinates are measured off hard copies of the mapping rather than using the digital co-ordinates.

Archaeological Services WYAS cannot accept responsibility for errors of fact or opinion resulting from data supplied by a third party.

Appendix 3: Geophysical archive

The geophysical archive comprises:-

- an archive disk containing compressed (WinZip 8) files of the raw data, report text (Microsoft Word 2000), and graphics files (Adobe Illustrator CS2 and AutoCAD 2008) files; and
- a full copy of the report.

At present the archive is held by Archaeological Services WYAS although it is anticipated that it may eventually be lodged with the Archaeology Data Service (ADS). The report will be made available for consultation in the West Sussex Historic Environment Record.

Bibliography

British Geological Survey, 2014. www.bgs.ac.uk/discoveringGeology/geology OfBritain/viewer.html . (Viewed November 27th 2014)

Cotswold Archaeology. 2014. *Land at Whitehouse Farm, Chichester: Evaluation Report*. Unpublished Client Report

David, A., N. Linford, P. Linford and L. Martin. 2008. *Geophysical Survey in Archaeological Field Evaluation: Research and Professional Services Guidelines (2nd edition)* English Heritage

Harrison, D. 2014. *Land at Whitehouse Farm, Chichester, West Sussex: Geophysical Survey Project Design* Unpublished Archaeological Services WYAS document

Institute for Archaeologists. 2014. *Standard and Guidance for archaeological geophysical survey.* IfA

Stratford, E. 2014. Land at Whitehouse Farm, Chichester: Archaeological and Heritage Assessment. Unpublished Environmental Dimension Partnership Client Report H_EDP29_25